CLAIMS

1. A porous formed article which comprises an organic polymer resin and an inorganic ion absorbing material and has communicating pores opening at an outer surface, wherein

the porous formed article has cavities in the interior of a fibril forming a communicating pore,

at least a part of said cavities opens at the surface of the fibril, and

the inorganic ion absorbing material is supported on the outer surface of said fibril and on the surface of inner cavities.

2. The porous formed article according to claim 1, wherein the communicating pores have a maximum pore diameter in a layer in the vicinity of the surface of the formed body.

3. The porous formed article according to any one of claims 1 and 2, wherein the porous formed article has an average particle diameter of 100 to 2,500 μm and is substantially spherical.

4. The porous formed article according to any one of claims 1 to 3, wherein the organic polymer resin comprises one or more selected from the group consisting of ethylene-vinylalcohol copolymer (EVOH), polyacrylonitrile (PAN), polysulfone (PS) and polyvinylidene fluoride (PVDF).

5. The porous formed article according to any one of claims 1 to 4, wherein the inorganic ion

absorbing material comprises a compound represented by the following formula (I) and/or the following formula (II):

$$MO_n \cdot mH_2O \quad (I)$$

$$M \cdot Fe_2O_4 \cdot mH_2O + xFe_3O_4 \cdot nH_2O \quad (II)$$

(wherein n is 1 to 4; m is 0.5 to 6; x is 0 to 3; and M is at least one metal selected from the group consisting of Ti, Zr, Sn, Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Al, Cr, Co, Ga, Fe, Mn, Ni, V, Ge, Nb and Ta: and in the formula (II), a symbol (+) denotes that the formula shows a mixture).

6. The porous formed article according to any one of claims 1 to 5, wherein the inorganic ion absorbing material comprises at least one selected from the group consisting of: a hydrated oxide of titanium, zirconium or tin; a hydrated ferrite of titanium, zirconium or tin; hydrated cerium oxide; hydrated lanthanum oxide; and activated alumina.

7. The porous formed article according to any one of claims 1 to 4, wherein the inorganic ion absorbing material comprises at least one selected from the group consisting of activated alumina impregnated with aluminum sulfate and activated carbon impregnated with aluminum sulfate.

8. The porous formed article according to any

one of claims 1 to 7, wherein the inorganic ion absorbing material has a particle diameter of 0.01 to 100 μm.

9. The porous formed article according to any one of claims 1 to 8, wherein the inorganic ion absorbing material in an amount of 30 to 95% is supported thereon.

10. The porous formed article according to any one of claims 1 to 9, wherein the fibril comprises the organic polymer resin, the inorganic ion absorbing material and a water-soluble polymer.

11. The porous formed article according to claim 10, wherein the water-soluble polymer is a synthetic polymer.

12. The porous formed article according to claim 10 or 11, wherein the water-soluble polymer is polyvinylpyrrolidone.

13. The porous formed article according to any one of claims 10 to 12, wherein the water-soluble polymer in an amount of 0.001 to 10% is contained therein.

14. A column packed with the porous formed article according to any one of claims 1 to 13.

15. A method for producing a porous formed article comprising an organic polymer resin and an inorganic ion absorbing material, which comprises the steps of mixing the organic polymer resin, a good solvent for the organic polymer resin, the inorganic

ion absorbing material and a water-soluble polymer; then forming the mixture into an article; and solidifying it in a poor solvent.

16. The method according to claim 15, wherein the good solvent for the organic polymer resin is one or more selected from the group consisting of dimethylsulfoxide (DMSO), N-methyl-2 pyrrolidone (NMP), dimethylacetamide (DMAC) and dimethylformamide (DMF).

17. The method according to claim 15 or 16, wherein the poor solvent is water, or a mixture of the good solvent for the organic polymer resin and water.

18. The method according to any one of claims 15 to 17, wherein a mixture ratio of the good solvent for the organic polymer resin to water in the mixture is 0 to 40%.

19. The method according to any one of claims 15 to 18, wherein the forming method comprises forming a droplet by scattering a slurry of the mixture of the organic polymer resin, the good solvent for the organic polymer resin, the inorganic ion absorbing material and the water-soluble polymer, from a nozzle provided on the side face of a rotating container.

20. An ion-adsorbing device for adsorbing ions in a liquid by passing the liquid through a column, wherein the column is packed with a porous formed article according to any one of claims 1 to 13.

21. An ion-adsorbing device characterized in that pH-controlling device is installed in a previous stage

of the column according to claim 20.

22. An ion-adsorbing device characterized in that a solid-liquid separation device is installed in a previous stage of the ion-adsorbing device according to claim 20 or 21.

23. The ion-adsorbing device according to claim 22, wherein the solid-liquid separation device is a membrane separation device.

24. The ion-adsorbing device according to any one of claims 20 to 23, further comprising water-sending means for supplying a desorption liquid to the column.

25. The ion-adsorbing device according to any one of claims 20 to 24, further comprising a crystallization tank, adding means for adding a crystallizing agent, a crystallizer provided with stirring means, and a solid-liquid separation device for separating precipitates produced in the crystallization tank into a solid and a liquid.

26. The ion-adsorbing device according to claim 25, wherein the solid-liquid separation device is a membrane separation device.

27. The ion-adsorbing device according to claim 25 or 26, further comprising liquid-supplying means for supplying an alkaline liquid which is obtained by separating a liquid from a solid after a crystallization reaction, to a column again.

28. The ion-adsorbing device according to any one of claims 20 to 27, further comprising liquid-supplying

means for supplying a pH-adjusting liquid to the column.

29. The ion-adsorbing device according to claim 28, capable of adjusting pH of a porous formed article packed in the column, which further comprises a pH-adjusting tank, a pH controller, a chemical liquid injection pump working with the pH controller, pH-adjusting-liquid-supplying means, and a line for passing water in the pH-adjusting tank to the column, to repeatedly circulate the pH-adjusting liquid between the column and the pH-adjusting tank and adjust the pH.

30. The ion-adsorbing device according to any one of claims 20 to 29, further comprising liquid-supplying means for supplying wash water to the column.

31. The ion-adsorbing device according to any one of claims 20 to 30, further comprising pH-adjusting means for adjusting pH of treatment water flowing out from the column.

32. A method for treating ions comprising contacting a liquid with the porous formed article according to any one of claims 1 to 13.

33. The method for treating ions according to claim 32, wherein the ions are P, B, F and/or As.

34. The method for treating ions according to claim 32 or 33, comprising adjusting pH of a solution and then adsorbing the ions.

35. The method for treating ions according to any one of claims 32 to 34, further comprising solid-

liquid-separating a solution and then adsorbing the ions.

36. The method for treating ions according to claim 35, wherein the means for solid-liquid-separating the solution is a membrane separation method.

37. The method for treating ions according to any one of claims 32 to 36, further comprising contacting the porous formed article according to any one of claims 1 to 13 which has adsorbed ions in water by contacting with a solution, with a desorption liquid to desorb adsorbed ions from the formed article.

38. The method for treating ions according to claim 37, wherein the desorption liquid is alkaline.

39. The method for treating ions according to claim 38, wherein the desorption liquid is a sodium hydroxide solution.

40. The method for treating ions according to any one of claims 37 to 39, wherein a desorption operation is conducted by adding a crystallizing agent to an alkaline aqueous solution having eluted the ions adsorbed in the formed article to precipitate the ions and subsequently separating the precipitate into a solid and a liquid.

41. The method for treating ions according to claim 40, wherein the method of solid-liquid separation is a membrane separation method.

42. The method for treating ions according to claim 40 or 41, wherein the crystallizing agent is a

hydroxide of a polyvalent metal.

43. The method for treating ions according to any one of claims 40 to 42, wherein the hydroxide of the polyvalent metal is calcium hydroxide.

44. The method for treating ions according to any one of claims 40 to 43, wherein the alkaline solution obtained by being separated from a mixed liquid of a solid and a liquid in a crystallization tank is supplied to a column again, and is reused for desorption.

45. The method for treating ions according to any one of claims 32 to 44, further comprising adjusting pH of the porous formed article packed in the column by supplying pH-adjusting liquid to a column.

46. The method for treating ions according to claim 45, wherein the pH of the porous formed article is adjusted by repeatedly circulating the pH-adjusting liquid between the column and pH-adjusting tank.

47. The method for treating ions according to claim 45 or 46, wherein the pH-adjusting liquid is an acidic aqueous solution.

48. The method for treating ions according to claim 47, wherein the acidic aqueous solution is an aqueous solution of sulfuric acid.

49. The method for treating ions according to any one of claims 32 to 48, further comprising supplying wash water in a reverse direction to that in the adsorption step.

50. The method for treating ions according to any one of claims 32 to 49, further comprising adjusting the pH of treatment water flowing out from the column.

51. A gas separation method comprising contacting a gas with the porous formed article according to any one of claims 1 to 13.

52. The separation method according to claim 51, wherein the gas is gaseous ethylene, hydrogen sulfide, ammonia and/or methyl mercaptan.

53. A porous absorbing product comprising the porous formed article according to any one of claims 1 to 13.